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EXPERIMENTAL INGESTION OF THE OVA OF *FASCIOLOPSIS BUSKI;* ALSO THE INGESTION OF ADULT *FASCIOLOPSIS BUSKI* FOR THE PURPOSE OF ARTIFICIAL INFESTATION

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The experimental ingestion of the eggs of *Fasciolopsis buski* was carried out for the purpose of determining the time which would normally elapse after the eggs were swallowed till they would appear in the stools. It was desirable to find out how long a time is required for a patient to become ova-free in order to have some time-basis for the dismissal of patients from the hospital wards.

It was also desired to find the length of time it would take for ova to appear in the stool if an egg-laying adult fluke were swallowed and the length of time before ova from such a fluke might be expected to disappear from the stool if the fluke did not lodge in the intestinal tract as a parasite. The effect of the digestive fluids on ingested ova was incidentally noted.

The following tables show the results of the experiment. Ova, for the experiment, were obtained from the stools of patients infested with *Fasciolopsis buski* only. They were washed and swallowed in ordinary gelatine capsules.

November 10, 1918, at 11:30 a. m. many thousands of ova were swallowed. At 2:00 p. m. stool, not washed. In one slide, 1 *Fasciolopsis buski* ovum. In one slide 1 Trichocephalus trichiurus ovum. Fve slides negative.

November 11, 1918. Stool at 2:00. Large sample washed. Four slides negative. Three slides each with 1 *Fasciolopsis buski* ovum, in one of which was also 1 *Trich. trich.* ovum.

November 12. No stool.

November 13. Stool at 7:30 a.m. Whole stool washed. Eight slides negative. One slide with 3 *Trich. trich.* ova, and one with two such. Five slides with 1 *Fasc. buski* ovum each in two of which were 2 *Trich. trich.* ova each and in a third three such.

November 14. Stool at 7:00 a. m. Washed. Five slides negative. One slide had one *Fasc. buski* ovum, one had two and one four such. Two slides showed one *Trich. trich.* ovum in each.

November 15. Stool at 6:20 a. m. Washed. Six slides negative. Two slides with 1 *Fasc. buski* ovum in each, one of which had also 5 *Trich. trich.* ova. One slide showed 2 *Trich. trich.* ova.

November 16. Stool at 9:00 p. m. Washed. Five slides negative. One slide had 1 *Trich. trich.* ovum, two had two each, and two had four each.

November 17. No stool.

November 18. Stool at 7:30 a. m. Washed. Ten slides examined. All Fasciolopsis negative.

November 25. Slight diarrhoea. Stool Fasciolopsis negative.

The eggs appeared on the same or the following day that they were ingested and disappeared in eight days from the day of ingestion. In ward-patients who had taken an anthelmintic and were freed from flukes, no eggs appeared after two days if the anthelmintic had been followed by a large saline purge and, in most instances, did not persist after the first day. This, I believe, is due to the large size of the eggs, the smoothness of their shells, and to their weight. They settle rapidly in water. From the appearance of the eggs voided after ingestion, they received no hurt in the stomach from the action of the digestive fluids. No empty shells were seen in the stools.

FEEDING EXPERIMENT

February 15, 1920. Three live flukes, from a human patient, were covered with bread dough and offered to a pig. On smelling of the dough, the pig refused it, doubtless detecting the presence of the flukes. It was then forcibly fed and the stools examined for a few days till they became ova-free, which occurred at the end of seven days. The attempt to infect the pig was not repeated.

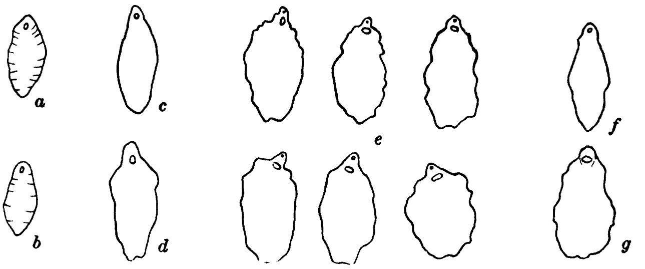

Fig. 1.—*Fasciolopsis buski* specimens traced in outline and swallowed at dates indicated: *a, b,* February 16, 1920; *c,* March 5, 1920; *d,* May 14, 1920; *e,* March 25, 1920; *f,* March 5, 1920; *g,* Fluke recovered alive, April 8, 1921. All figures one half natural size.

FIRST INGESTION EXPERIMENT

The care and attention incident upon the transportation of experimental animals from China to America making their use impracticable and it being imperative to have living eggs for the purpose of studying their development, the author undertook to infest himself by swallowing adult flukes obtained from Chinese patients by the use of anthelmentics.

February 16, 1920, at 5:30 p. m. two *Fasciolopsis buski* were traced and swallowed Fig. 1, *a, b.*

The first stool passed at 10:00 p. m. of the same day showed no signs of flukes or of ova.

February 17 at 11:30 p. m. the second stool examined showed no flukes and but two ova in ten slides.

February 18, at 9:30 p. m. the third stool examined showed no flukes and but one ovum.

February 19, at 4:30 p. m. the fourth stool examined showed no ova.

February 20, at 3:00 p. m. the fifth stool examined showed no ova.

None of the succeeding stools for a number of days showed any ova and the experiment was deemed unsuccessful. As the flukes were swallowed on an empty stomach it is possible that they were digested before passing into the intestine and the following experiment would seem to corroborate this opinion.

SECOND INGESTION EXPERIMENT

March 5, 1920, at 11: 50 a. m., three live *Fasciolopsis buski* were swallowed after administration of half a drachm of soda bicarbonate and were followed by one ounce of condensed milk. These flukes were taken just before eating lunch. They were recovered from a patient by the use of B-naphthol and when swallowed were of the color of Tallquist scale 95 per cent. All about the same size (Fig. 1, c.).

March 6, at 3:30 p. m. the first stool showed two ova in the first slide and five ova and one empty shell in the second slide. March 7, at 4:20 p. m. the second stool showed two ova in one slide. March 8, at 7:35 a. m. the third stool showed two ova to one slide. March 9, at 2:30 p. m. the fourth stool showed no ova in the first slide and only one in the second slide. March 10, at 7:00 a. m. the fifth stool showed one ovum in two slides. March 11, at 8:00 p. m. the sixth stool was not examined. March 12, at 10:00 a. m. the seventh stool showed one ovum in the first slide. March 22, at 1:00 p. m. the first slide showed five ova, the second 7 ova.

THIRD INGESTION EXPERIMENT

March 25, 1920. At 3:15 p. m., after a full meal, the six flukes were traced (Fig. 1, *e*) and swallowed. Their color viewed by transmitted light was about like Tallquist's haemaglobin scale 80 per cent., but by reflected light much darker than Tallquist 100 per cent.

March 26 to May 8 stools were examined and all showed ova. May 8, 1920, at 7:30 a. m. one slide showed three ova. This stool weighed 2,734 grains and contained 54 ova in 5 grains of stool. Estimated 29,500 ova in the whole stool. Stools were examined intermittently from the time of the second ingestion experiment and there was no time when they were not present in the stools, until the infestation was finally terminated.

FOURTH INGESTION EXPERIMENT

May 13, 1920, at 2: 20 p. m., after a full meal, fifteen flukes were traced (Fig. 2, *a*) and swallowed in saline solution. In color they were about like those of the preceeding experiment. May 14, 1920, at 9 a. m., ten flukes were swallowed, all about the size of the traced fluke (Fig. 1, *d*). In all, thirty-six flukes were swallowed. The first two were unable to survive. The second ingestion was successful in establishing infestation. From March 6, 1920, until April 8, 1921, the stools were never free from ova. April 7, 1921, in order to rid himself of the infestation, the author took the following treatment:

At 6 p. m. magnesium sulphate oz. ½, fasting. April 8, 1921, at 7 a. m. B-naphthol gr. 30, taken fasting. At 7: 30 a. m. B-naphthol gr. 20, taken fasting. At 8 a. m. B-naphthol gr. 20, taken fasting.

This was followed by one ounce of magnesium sulphate at 10 a. m. fasting. After free catharsis no flukes were passed so treatment was repeated as follows: B-naphthol gr. 20 at 1: 30 p. m., gr. 20 at 2 p. m. and gr. 10 at 2: 30, all taken fasting followed by magnesium sulphate oz. 1. After repeated stools, at 6:25 p. m., one live fluke was passed. It was nearly denuded of epithelium and spermatic fluid was oozing from the open terminals of the testes. It lived but a short time after being passed, but was traced alive April 8, 1921 (Fig. 2, *b*). It was 3 mm. thick and showed spots of epithelium still remaining.

April 9, no stool, magnesium sulphate ½ oz. was taken. April 10 to 18 all stools were washed and most carefully examined but no ova were found. Since that date a number of examinations have been made but no ova have been found. The last examination was made May 26, 1921.

Shreds of macerated flukes were searched for in all stools passed from April 8 to April 14, but there was nothing to indicate that there was present more than the one fluke, which was recovered. From the above data it would seem reasonably certain that the fluke recovered was one of the three ingested March 5, 1920, as ova were constantly present from that date and twenty days elapsed between the date of their ingestion and the third ingestion experiment.

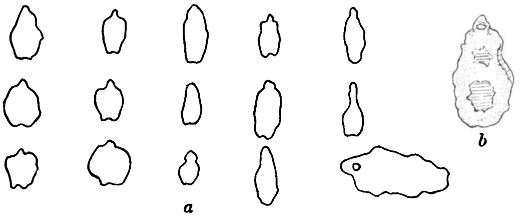

Fig. 2.—*Fasciolopsis buski* specimens swallowed as follows: *a*, May 13, 1920; *b*, April 8, 1921. Figures one half natural size.

A comparison of the two flukes can be made from tracings of March 5, 1920 (Fig. 1, *f*) and April 8, 1921 (*g*). The outlines do not show the full extent of the difference in size as A is thinner than B, being only 2 as against 3 mm. thick and much more fully extended. March 31, 1921. Differential blood-count: Total leukocytes estimated, 8,000; L. Mononuclears 7.6; S. mononuclears, 23.0; polynuclears, 62.0; eosinophils, 6.3; basophils, 1.1. Morphological examination showed no extensive abnormalities. Platelets not increased.

It is interesting to note that some symptoms of a mild nature were observed by the patient, but that, considering the fact that he harbored but one fluke, these symptoms were probably psychological, though some mild edema was observed just prior to taking treatment. The swallowing of these flukes was indeed a nauseating process even though the experimenter went into the dark-room to take them. They were put through a preliminary washing with alcohol and then washed thoroughly in saline solution.

All of the ova used in the study of the development of the eggs of *Fasciolopsis buski* were obtained from the one fluke which is evidence of the fact that cross-fertilization in these trematodes is not essential to the production of fertile ova. From a number of estimates made at various times from weighed stools, this one fluke passed from nine to twelve thousand ova daily.

So far as can be ascertained from literature at my command, there is no record of adult parasites being obtained by means of anthelmintics from one primary host and being fed to a different individual of the parasite's primary host with a resulting infestation of the second primary host.

CONCLUSIONS

Ingested ova appear in the normal stool as early as two and a half hours after being swallowed in gelatin capsules.

Patients become ova-free in from one to eight days without the use of cathartics and in from ten hours to two days after free catharsis.

After swallowing two live flukes which did not become parasitic, ova appeared in eighteen hours and disappeared in seventy-one hours.

Twenty-eight hours after swallowing three live flukes, one of which lodged and became parasitic, ova appeared in the stool and did not again disappear till a year later when an anthelmintic was taken and the adult fluke was expelled.

Some growth is noted in the fluke which stayed in but the growth is less than might be expected over a period of more than a year.

Eggs obtained from a single fluke infestation are fertile and have been hatched and the miracidium studied.